

**APPROPRIATE TECHNOLOGIES IN
SUB-SAHARAN AFRICA**

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1. Some remarks on the concept of "Appropriate Technologies"

Appropriate technologies in developing countries should be understood as technologies most appropriate from the point of view of socio-economic criteria, which contribute to economic development and ensure optimal use of resources and protection of the natural environment. These technologies should pave the way for a gradual increase of labour productivity and improvement of technical culture of broad masses of the population (i.e. they should be adapted to the majority of society and not to narrow groups of people). However, such a definition is too general to find practical application and therefore it calls for some more precise formulation.

Firstly, appropriate technology encompasses both economic and non-economic criteria (e.g. cultural and ecological). Economic profitability of an individual producer becomes a necessary but not sufficient condition for selecting a technique of production. Appropriate technologies, in line with social effectiveness criteria, attempt to reconcile the interest of an individual producer with the social interest.

Secondly, this definition places emphasis on effects and not on types of applied technologies. A description of a technology alone does not indicate whether it is appropriate, because the effects of applying a given technology are of utmost importance, e.g. quality of a given product.

Thirdly, this term does not distinguish between technologies

with different levels of modernity (e.g. starting from intermediate technologies and ending with the most modern ones). It is therefore necessary to divide appropriate technologies into simple appropriate technologies and modern appropriate technologies.

Fourthly, it is a common practice - in relation to developing countries - for appropriate technology to be understood in its narrow colloquial sense, i.e. as a technology which is adapted in labour resources and their qualifications, or in other words as a labour-intensive, small-scale and cheap technology.

Fifthly, such characteristics as labour-intensity, small scale, etc. may determine the appropriateness of a given production technology when technologies of this type exist in a specific branch of production. In the case of certain kinds of products or services simple production technologies may not be available at all - it is necessary to apply a capital-intensive technology or not to launch production. Then the problem of appropriateness shifts from production technologies to the product itself. Provided the latter is very important for social welfare (e.g. protection of environment, transport and communications) then technologies realizing it must be considered appropriate.

Much more could be added to the above definition to make it more precise. To improve understanding of appropriate technologies it is necessary to discuss some additional issues. Appropriate technologies may prove to be a convenient solution

for a shift from the traditional economy to a more modern economy, they may constitute an effective instrument for modernization of certain sectors of the national economy, or they may allow a technological gap to be filled successfully.

The concept of appropriate technologies does not exclude co-existence, within the framework of the same economy, of various technical-organizational solutions. Numerous theoretical controversies have arisen over whether the thinking in categories of appropriate technologies (in their broad sense) should encompass the entire national economy or only some of its sectors. Part of the misunderstanding resulted from an imprecise definition of "appropriate technology", because some scholars tended to mix the concept of appropriate technologies with the concept of intermediate technologies (the latter has obviously a narrower scope). Also in relation to the concept of appropriate technologies, opinions are sometimes expressed that these technologies have limited possibilities of application, for example, only at the level of family protection and small production plants. Consequently, appropriate technologies are supposed to perform a restricted role as a "makeshift solution" (e.g. ensuring employment and incomes for rural population) and not a role as part of a general development strategy. Some supporters of intermediate and appropriate technologies also failed to realize that it is necessary to introduce modern technological solutions both in the agricultural and in the non-agricultural sector, which was an obvious weakness of their argument. While criticizing - quite rightly - blind imitation of

Western technologies and products, no allowance was made for other more modern but fully appropriate solutions (e.g. biotechnology, technologies for utilization of solar energy, etc.) in many sectors of the national economy. Of course, some spheres of the socio-economic life are especially receptive to appropriate technologies, for instance, production of energy, agricultural production, construction, expansion of road infrastructure, and so on. That does not imply, however, that simple and modern appropriate technologies should not be introduced everywhere they can find application and not only in arbitrarily selected sectors of the national economy. It is obviously highly unlikely that appropriate technologies will be installed in the entire national economy, because it is simply not feasible. These technologies would accomplish their task even if they could saturate the economy at least partly (e.g. over 20%-30%).

For most African countries, the basic problem is to develop the rural sector and here appropriate technologies can find the biggest possibilities of application. The majority of scholars prove that these countries primarily need small-scale labour-intensive technologies, which do not stand in contradiction with their socio-economic structures. G. Myrdal was right in saying that in these countries a new agricultural technology must assume¹ an extremely intensive character as regards input of labour.

¹ G. Myrdal, *The Challenge of World Poverty*, Penguin 1970.

He went on to say that social, customary, economic, etc. considerations pointed against adoption of the modern technology coming from highly-developed countries, and these could not be pushed aside in a sudden and revolutionary way even if supply of such technologies could be secured.

It is not difficult to prove that the more backward a country is the more it needs simple appropriate technologies, which in given conditions may constitute the most effective technical-organizational solutions. In a situation of unemployment, economic growth requiring heavy investment outlays is much less effective. It becomes necessary to search for technologies which will increase economic effectiveness without substantial additional investment outlays. A country possessing an abundant labour force may hope to obtain better results in selecting technologies which allow a decrease in unemployment. Simple appropriate technologies afford an opportunity for productivity increase without relying on extra investment. That is of great importance in the case of the most backward countries, in which acceleration of development is connected with institutional, cultural, social, etc. changes. If technologies are better adapted to a worker's mentality, his habits, rhythm of work, etc. then a higher productivity can be expected of him. That is possible owing to a gradual improvement of skills and constant improvement in workers' technical qualifications. In other words, a main advantage of these technologies is not only that they are more effective today but also that they guarantee non-investment growth of productivity in the future (much greater

than in the case of capital-intensive technologies).

Modern technological innovations are known to be taking place mainly within the sphere of modern, capital-intensive, etc. technologies in highly-developed countries. The main trends in technical progress change according to the stage of economic development achieved and the state of development of science. Taking into account the fact that in the world today competition takes place mainly in the technological sphere, a relatively high share of the GNP is earmarked for research and development activities in industrialized countries. The most important directions of technical progress in the last few decades and at the present time include, among others, electrification, chemicalization, automation, computerization, etc. Common application of electronics, which is extending to an increasing number of industries and services is of immense importance for promotion of technical progress. There is no doubt that technical progress inducing a bigger capital-intensity (using here M. Kalecki's terminology)² dominates in the world economy. The problem does not only lie in lack of access of developing countries to technical progress of this type, but also in low effectiveness of these technologies in conditions of the Third World, and in limited possibilities of/or their introduction and diffusion. In countries where e.g. a scythe is a "rational" technique in agriculture, improvements in construction of bulldozers will not exert any influence on the effectiveness of

² M. Kalecki, Outline of Growth Theory of Socialist Economy, Warsaw 1968, pp. 68-71 (in Polish).

investments (and conversely). Developing countries require, first of all, such technical progress (discouraging capital-intensity), in which the growth rate of labour productivity is higher than that of the capital-labour ratio. And simple appropriate technologies involve such technical progress.

Yet another important aspect of the application of simple appropriate technologies in developing countries remains to be discussed. Choice of production technologies is known to be influenced very strongly by conditions in which the producer is functioning. The situation of the capitalist entrepreneur employing hired labour is fundamentally different from that of the individual or self-employed producer (i.e. a family (tribal) or cooperative undertaking) who does not employ such labour. The capitalist entrepreneur will find it profitable to increase employment only from the moment at which his employee's productivity matches the pay obtained by him. Employment of additional employees - at a given level of pay (fixed by the market and independent of the producer) - would lead to losses suffered by an enterprise. In other words, it is impossible for the capitalist entrepreneur to employ workers below the obligatory wage rates.

Meanwhile, the individual producer can afford to employ the entire labour force remaining at his disposal irrespective of its productivity level. In this case, any production increment obtained through work of family members increases the family's incomes. In such situation, an appropriate technology for the

individual producer will always be a technology more labour-intensive than that which will be applied by the capitalist entrepreneur. That is why simple appropriate technologies always find a wide application in countries with a large number of family undertakings (agricultural, handicraft, etc.), as in much of Sub-Saharan Africa.

2. Appropriate technologies as a chance for development of African countries.

Various specific characteristics of African countries create favourable conditions for diffusion of both simple and modern appropriate technologies. Application of simple appropriate technologies (labour-intensive ones) is prompted primarily by such factors as surplus of labour and shortage of capital, predominance of the rural sector (including a substantial share of subsistence economy), of family undertakings, African "solidarity", and possibilities of expansion of the cooperative sector, active participation of Africa women, etc. Moreover, numerous other factors (e.g. intensive insulation) create potential possibilities for development of modern appropriate technologies.

The economic development of African countries calls for changes in the existing way of thinking. The new way of thinking should take into consideration the real needs of the local population. As it is known many African countries following the recommendations of the International Monetary Fund and the World Bank continue to observe the neoclassical theory of economic growth, according to which economic growth and technical progress will be promoted properly when the state authorities adopt well-

conceived measures of economic policy including, among others, providing a guarantee for realization of the most profitable activities to private enterprises, inviting foreign capital and ensuring its free operation in a given country, creating more favourable opportunities for development of foreign trade, and so on.

Till now these activities have not allowed Sub-Saharan Africa to overcome its state of economic underdevelopment although they have sometimes proved effective in the case of other developing countries. Sub-Saharan Africa can however, hardly be compared with South East Asia or Latin America. Its development barriers are of a fundamentally different character and, therefore, African countries' economic growth should not be steered by means of neoclassical market instruments (as it happened in newly-industrialized Asiatic countries).

In the eighties, the economic situation in Sub-Saharan Africa was further aggravated. The most pronounced stagnation can be observed, first of all, in the traditional sector (grouping 60-90% of the population), which remains practically on the periphery of socio-economic transformations. Living standards and labour productivity of those employed in the traditional sector do not differ almost at all from their level hundreds of years ago. According to the UN estimates concerning this sector in Africa, the value added (expressed in constant prices per one inhabitant) was increasing at an average annual rate of 0.1% over the period 1960-1967. This index has not increased during the last twenty years. It means that with such a

rate of growth Sub-Saharan Africa has not got even the smallest chance of overcoming its economic backwardness in the coming years or even decades.

Thus, it is desirable to activate those forces which have traditionally animated rural communities, because technical-organizational solutions imposed "from outside" will not have any greater chance of acceptance. It is theoretically possible to imagine a type of development based on mass inflow of external capital and technological assistance. That would not be, however, a remedy for the majority of poor African countries, because external capital as such will not generate development unless desirable socio-political conditions in the receiving country, and using E.F. Schumacher's terminology³ - if the level of "education, organization and discipline of work" does not attain a certain indispensable critical mass. Of course, foreign aid for African countries is absolutely necessary, but it is most important for these countries to assume full responsibility for their own development relying mainly on their own capacities.

The views which the potential for economic development are particularly relevant in African conditions.⁴ In a vast majority of African countries agriculture constitutes the main sector of production and hence, economic development should be determined, to a extent, by development of agriculture.

The ultimate target of these countries should be implementation of a strategy of balanced development of

3 E.F. Schumacher, Small is Beautiful, Glasgow 1973.

4 See e.g.: J.W. Mellor, The New Economics of Growth: A Strategy for India and the Developing World, London 1976.

agriculture and industry, with an especially active role played by agriculture. In a longer time perspective, development could be divided into three main stages (this distinction does not mean that the stages will be distinctly separated, because in some cases they may overlap in perspective:

(a) the first stage dominated by agricultural production (possibly aided by production of extractive industries) for satisfaction of needs and for export;

(b) the second stage, in which a surplus obtained during the first stage will be allocated for development of consumer goods industries import substituting;

(c) the third stage restricted, to those countries which are characterized by sufficiently high effective demand, when investment funds will be earmarked for development of capital goods industries (on the basis of profits obtained in the second stage).

Appropriate technologies would play a significant role in all three stages of development, and especially in the first stage. It should be underlined that we do not mean here a full saturation of the national economy with these technologies, as that is completely unreal. It may be accepted that appropriate technology would fulfill its task in Africa even if it allowed, according to concrete conditions, to generate 20-30% of the Gross National Product. Accomplishment of this task calls for acceptance of an entirely different developmental cycle, which

consists in giving priority to development of decentralized agriculture and small-scale industry, striving to liquidate gradually the dualistic economic structure, promoting more equitable distribution of the national income, etc. Appropriate technologies provide a chance of releasing cumulative effects. Increase in employment and higher labour productivity should contribute to higher purchasing power of the population with low incomes and larger effective demand for local products (in the initial period, growth of incomes would be too low to generate growth of demand for expensive consumer durables of foreign origin). This, in turn, could contribute to development of various industries supplying the domestic market, which would become a stimulus for a gradual transformation of the traditional sector. In the sphere of technology, it would generate demand for appropriate technologies, selective substitution of external technology, and gradual expansion of local research and development activity. These undertakings would promote, in turn, further development and small and medium-sized industrial firms and agricultural farms, etc. In this way, the cycle is closed.

By raising the technical culture of masses, improving organization and discipline of work, increasing incomes of large groups of the population, etc. appropriate technologies afford a real chance for a gradual breaking and "take off" of traditional social structures in African countries. In the situation when social forces able to carry out more radical transformations in Sub-Saharan Africa are absent, these technologies might become an important instrument for realization of far-reaching social changes. It is not an exaggeration to hypothesize that

appropriate technologies are both a unique chance and virtually a vital necessity for African countries. According to the opinion formulated by the African Ngos Environment Network of 1987, fully shared by the author, Africa seeks a new equilibrium based on decentralization of economic life. Indeed, decentralization ensures a more stable model of development than systems which are centralized on a big scale. While industrialized countries utilize capital-intensive technology, as was mentioned above, African countries will be obliged to rely on labour-intensive technologies for a long time to come.⁵

At the present time, studies on appropriate technologies in Sub-Saharan Africa encompass many different sectors, but they are mainly focused on the following:

1. Renewable energy, 2. Agricultural production, 3. Construction, 4. Transport, 5. Others (services, health protection, etc.). The fact that theoreticians and practitioners tend to focus their attention on these areas follows for the assumption that improvement of production technologies should, first of all, promote development of the rural sector, revive agricultural production and contribute to increase of value added in manufactured goods.

3. Real chances for diffusion of appropriate technologies

Diffusion of appropriate technologies in African countries encounters, as mentioned earlier, numerous obstacles both at macro and micro levels. Hitherto, the main problem

5 The African Ngos Environment Network, IFDA Dossier 59, May-June 1987, pp. 31-41.

appears to be the fact that choices of technologies made at the macro level fall wide (with a few exceptions) of the real needs of the micro level. Effective diffusion and introduction of appropriate technologies on a wide scale and achievement of planned benefits will depend both on support provided by the public authorities and on readiness of the African population to accept these techniques. Both present highly complex problems. In most African countries, proper conditions for the introduction of appropriate technologies have not been created at either the macro or the micro level.

The present speed of institutional and policy changes is too slow to attain a critical point, i.e. a situation in which a feedback between technology and socio-economic conditions of African countries can appear (when production based on appropriate technologies will exert a stimulating impact on socio-economic conditions and on improvement of general technical culture).

When arguing in favour of the concept of appropriate technologies (which primarily stresses internal factors of development), it must not be forgotten that development of Sub-Saharan Africa is also (and perhaps above all) a political problem. Apart from very important internal problems, there are problems of relations with the highly-developed world, participation in international trade, foreign aid, issues of unity and possibility of integration of these countries, etc. It is also known that diffusion of appropriate technologies on a

wide scale, because only such scale may be effective, must cause, among others, considerable difficulties in financing programmes of modern sector development, which may be faced with different forms of the rationing of capital (e.g. substantial increase of interest rates). That may arouse a firm resistance on the part of "big business" and of the bureaucratic class linked with it. Meanwhile, for diffusion of appropriate technology it is necessary to effect changes in the economic policy of African countries, as well as various other institutional changes.

Many governments of African countries provide - more or less verbal - support for appropriate technologies. There is growing interest in these technologies both among the public authorities in particular countries and international organizations (e.g. UNIDO, UNESCO, UNICEF, ATI, etc.). In 1985, African countries already had 711 institutions dealing with search for new technical solutions (including appropriate technologies). Relatively biggest interest in appropriate technologies can be observed in Kenya, Nigeria, Burkina Faso, Ghana, Zambia, Tanzania, Malawi, Zaire, and Botswana, and the smallest in Angola, Mozambique, Chad and Somalia.⁶

And although the support of the public authorities for appropriate technologies is an indispensable precondition, it is not yet a sufficient condition for effective diffusion of these

⁶ J. C Woillet and M. Allai, Directory of African Technology Institutions, vol. I and II, ILO Geneva 1985.

technologies. It is a matter of primary importance to elaborate a comprehensive concept of a country's development that would envisage wide utilization of appropriate technologies. The analysis of various technological options (starting from traditional an ending with the most modern technologies) should be preceded by explicit determination of development goals. These activities inspired at the macro level should be carried out simultaneously in many spheres, for example organization of educational system and research and development activity, credit assistance, development of local production or import of appropriate technologies, organization of information flow and designing of improved technologies, etc.

The organization of the educational system in African countries maintains an antidevelopment character, with the emphasis laid on academic education (mainly on the humanities), and simultaneous neglect of development of vocational schooling, which can hardly lend to improving the level of technical culture of broad masses of the population. Hitherto education in the majority of African countries has been very weakly interrelated with agriculture and the rural sector. Educational and training services for the small-scale production sector (formal and informal) are almost non-existent. Various religious missions deal with it, to some extent, but their assistance is insufficient. In this context, it is unlikely that big-scale and effective activities could be launched, aiming at adaptation of modern technology to local conditions. It is necessary to modify the system of education and intensify efforts aiming at

development of vocational education. Simultaneously, it would be most advisable to set up groups of experts (at national and regional levels), which would analyse requirement of the rural sector and provide advice and assistance for small private firms, family undertakings, etc. Direct producers must become acquainted with improved utilization of tools, obtaining greater economic effectiveness, possibilities of selling agricultural surpluses in the market, and other related issues. Such groups of experts might be set up within the framework of existing research institutions (e.g. universities) with assistance being provided by international organizations (such as UNIDO, UNESCO, ILO, and others).

The public authorities in African countries might make their greater contribution to acceleration of diffusion of these technologies through expansion of the credit system, proper subsidies, price and tax incentives for small private firms, etc. Previously (including, among others, Malawi), the small-scale production sector was commonly neglected or discriminated against. The majority of African countries pursue a policy of excessively low prices for agricultural products, which does not promote development of agriculture and villages. Higher prices for agricultural items and subsidies for agriculture would have a beneficial impact on growth of food production and farmers' incomes. Credit assistance for the small-scale industrial sector and agricultural farms would be of great significance for diffusion of appropriate technologies. An important role in accomplishment of this task could be played, first of all, by development banks and by government agencies. Insufficient

assistance provided by these institutions is acutely felt by the weakest social groups, small private enterprises, family undertakings and farms, etc. Large and modern capitalist enterprises are able to survive regardless of the size of credit assistance granted by local development banks.

Until the early eighties, the vast majority of African countries did not have an effective programme of assistance for small firms (more important changes were introduced when the Lagos Plan of Action was adopted).⁷ Since the end of the seventies we can observe some changes in the functioning of development banks. For instance, the NIDB of Nigeria had not been analyzing capital-intensity of investment projects at all till the mid-70's, and it had been generally choosing capital-intensive and most modern technologies.⁸ The main cause of a change in the policy pursued by this bank in favour of capital-saving and smaller scale projects was a sharp drop in hard currency revenues of Nigeria at the turn of the eighties.

It is worth mentioning briefly yet another problem at this point i.e. who should deal with local production and distribution of mainly simple appropriate technologies. This task could be successfully tackled by the large-scale industrial sector (public, private, or multinational) in its own interest. The main problem lies, however, in absence of a feedback between this sector and agriculture and in lack of information about the size

7 UNIDO, A Programme For the Industrial Development Decade For Africa, New York 1982, pp. 131-135.

8 B. Balkenhol, Technology Policy and Development Financing: Observations on Some Institutional Constraints in Africa, ILO, GENEVA, 1980, P. 16.

of effective demand for appropriate technologies (this enhances the risk of investing capital ineffectively). Also in this case the intervention of the public authorities becomes necessary.

Through a system of economic incentives (grants, lower taxes, etc.) they could promote growth of supply of simple appropriate technologies.

Activities at the macro level in favour of appropriate technologies, which have been very limited so far, will not suffice to ensure effective introduction and diffusion of these technologies at the micro level. First of all, appropriate technologies must be accepted by their direct users, that is by the African population.

As is known, appropriate technology may come from endogenous sources (simple) or exogenous sources (simple and modern). In the first case it would be necessary to have traditional technologies improved by the users themselves (e.g. with assistance provided by local research and development centres). In the second case, the technology may be either second-hand, that can be utilized in a given country or region, or a completely new (simple or modern) technology, which has been adapted to local conditions (e.g. with assistance of international organizations). Diffusion of the appropriate endogenous technology will probably be least troublesome. Gradual improvement of work tools by the users themselves increases confidence in their own abilities, does not involve too big risk or substantial expenditure. These are simple and cheap technologies, fully adapted to local cultural and socio-economic

conditions. Practice proves, however, that such endogenous modifications (if they exist at all) are of very limited nature. On the other hand, many major barriers (e.g. economic and cultural) appear in the case of appropriate exogenous technologies. There can occur here an apparent paradox, namely technologies, which cannot go beyond their experimental stage, are - ex definitions - inappropriate, because if they really were appropriate then they would automatically be in effective demand among local users. In the reality, even the best ideas encounter major obstacles in their introduction especially in isolated and conservative rural circles. Traditional behaviour patterns represent some of the most difficult obstacles in the process of adaptation of new technologies, while any threat to these patterns generates dissatisfaction and resistance. Peasants often use the same techniques which were used by their forefathers, because these techniques proved their applicability a long time ago and they are also useful in meeting specific needs. For example, in many regions of African countries the population uses very primitive and in fact archaic tools (e.g. sticks, hoes, machetes, and others), which have not undergone even the smallest transformations for hundreds of years. An attempt to explain this phenomenon was made by Polish sociologist S. Czarnowski many years ago. He wrote, "...peregrinations of a tool are a complex problem and their success is determined by its structure, organization of work, organization of spiritual life of a community taking it over."⁹ According to Czarnowski

⁹ S. Czarnowski, Culture, "Ksiazka" 1946, pp. 178-189 (in Polish.)

"technical adoption" is possible when appropriate conditions are fulfilled. He quotes an example of two techniques of land cultivation: ploughing and hoeing, to which different tools correspond, i.e. in the case of ploughing - from a primitive to more refined plough, and in hoeing - from a pickaxe to a hoe. On the one hand, some technique may be replaced by another one (digging by agriculture) and, on the other hand, a more primitive tool may be replaced by a more improved tool. In Czarnowski's opinion, digging is a female and small families' technique, and agriculture - a male technique assuming a uniform organization of agricultural production in bigger areas. Czarnowski goes on to say, "In fact, among all those peoples such as the already mentioned inhabitants of Ruanda country, cultivation of land is exclusively the task of females and children". In this way, by taking over a plough the peoples applying a digging technique were made to transform their entire system of land use and its division, which meant that their women became jobless, although they are the main suppliers of labour in Africa. It can thus be seen that in numerous cases obsolete technical tools correspond to an out-dated social system. In the opinion of a considerable part of the African population, work in fields continues to be treated as extension of a household and, consequently, it constitutes an almost exclusive domain of women. Hence, as a rule, uneducated women in rural areas constitute the basis of agricultural production in most African countries. Introduction of modern and capital-intensive technical organizational solutions restricts the socio-economic functions of an African

woman, who assumes a peripheral role in society (usually a woman is shifted from the production sector to services). Too rapid changes of this kind cause a number of social and economic disturbances (e.g. men are not always capable of taking over female production functions). It is increasingly accepted that more appropriate labour-intensive technologies would be gradually improved thus paving the way for evolutionary social transformations allowing the avoidance of a violent change in a woman's role. Owing to such technologies it would be possible to avoid untimely destruction of rural life and increased dependence on external forces. Technological gradualism creates an opportunity for development "from the scratch", and makes possible survival and preservation of values rooted in one's own traditions (e.g. strong family ties, prestige enjoyed by parents, etc.). Thinking in categories of what is accessible and relatively cheap, and what can be operated by the local population, will not only permit the avoidance and disintegration of society but also the attainment of greater economic effectiveness.

It must be remembered that traditional techniques prove inadequate under pressure of rapidly growing food demand, for example, by fast population increase. At such a time, there may appear a "softened" interest in new appropriate technologies among peasants. However, adoption of new technical solutions involves multiple changes in the entire cultural configuration of a given community. As a rule it does not end with adoption of individual technologies either, since it involves adoption of a

whole group of functionally interlinked technologies. In the case of appropriate technology, it will not be enough to overcome the cultural barrier alone, because there must be fulfilled in parallel two main conditions: (1) the rural population must be properly informed about the existence of a given technology, and (2) this technology must be also much more effective than the traditionally applied technology to compensate for the risk connected with its introduction.

As regards the first condition, information alone about the existence of a given appropriate technology will not suffice. It is necessary to employ proper forms of training of a verbal and visual character and means of demonstration. Those directly interested must get acquainted with the functioning of a given technology in practice. It becomes indispensable to answer several questions such as: what can be achieved through application of a new technology?; in what way does it facilitate work?; are there involved a single technology or a group of new functionally interlinked technologies? etc. The main criterion should be its higher effectiveness in comparison with a technology used at present. In some very simple situations, a single demonstration of a given technology is sufficient, but in the case of more complex technologies a longer period of learning-by-doing becomes necessary (connected with development of vocational education and training). At the present time, information in Africa about appropriate technologies is rather insignificant. There is nobody willing to propagate these technologies and indispensable financial resources for such activity are missing as well. That is done, to a limited extent,

by academic centres, international organizations, religious missions, and only a few government agencies.

With regard to the second condition, it should be noted that in the case of the rural sector peasants would be more willing to introduce appropriate technologies if this was to lead to improvement of their material situation. As has been mentioned they are, however, very cautious about investing in uncertain and untested technologies, which involve a major element of risk. Peasants are too poor to risk deterioration of their already extremely low living standards. While employing traditional technologies (even the most archaic) they know what they can expect and on what production effects to count. Meanwhile, the new technology implies not only the necessity of incurring an additional financial outlay but also uncertainty as regards its success. Peasants will not rest satisfied with a possibility of increasing their agricultural production above the subsistence level by means of a given technology, they must also have a profitable sale of produced surplus guaranteed. If they do not manage to sell their surplus agricultural products at attractive prices they will not have any motivation to increase production and, consequently, to introduce and improve technology. There must exist not only an effective demand for produced agricultural articles but also a sufficient supply of such goods and services for which African peasants would be willing to allocate their additional incomes. According to a report of the International Labour Organization on appropriate technologies in Zambia in all those places where proper factors of production are available and

where prices for agricultural articles are favourable small farmers do their best to contribute to increase of agricultural production.¹⁰

The observations made by the author in Southern Shaba show that the African village accepts new technical-organizational solutions most unwillingly even if they are relatively adapted and yield considerable benefits for a given community. Over the years 1982-1985, on the initiative of the University of Lubumbashi (UNILU) various attempts were launched to apply appropriate technologies in nearby villages.¹¹ These included:

- solar batteries in Katanga village (near Likasi) - an experiment conducted in cooperation with the University of Mons (Belgium).
- technologies based on utilization of wind energy and biogas in Ruashi - an initiative of the Faculty of Polytechnic at the UNILU (foreign experts from Assistance Technique Belge).
- new methods of cultivation and animal breeding (cooperation between the Faculty of Veterinary at the UNILU and Cooperation Allemande (FRG)).

In all three cases, technologies were provided by the highly-developed countries, with foreign experts being responsible for their introduction. These technologies did not go beyond an

10 ILO, *Appropriate Farm Equipment Technology for the Small Scale Traditional Sector: the case of Zambia*, Geneva 1983, pp. 96-97

11 UNILU. BP. 1825, Lubumbashi (Zaire).

initial experimental stage, there was no major change in organization of village life, nor any noticeable increase in professional activity of its inhabitants. In the case of Ruashi (wind energy and biogas), the experiment was suspended in 1986 due to shortage of financial resources, departure of experts, and lack of any bigger interest in it on the part of local inhabitants. It is worth underlining that in all these cases the initiatives enjoyed considerable support of the university and local authorities. And although other attempts to adopt appropriate technologies were continued in the second half of the eighties the chances for wider diffusion of these technological solutions were quite insignificant. Besides financial difficulties, the main causes of failures of some experiments were: poor technical preparation (a wind generator could not reach expected capacity), wrong understanding of a technology, deficit of spare parts (e.g. solar batteries), unfamiliarity with know-how (foreign experts knew how to operate technologies), or neglect of cultural barriers (experiments with biogas in Ruashi). The main impediment, however, was the fact that the local population - in spite of obvious advantages of electric current (in village of Katanga) - was not sufficiently interested in the success of these experiments. Village inhabitants were treating these technologies as "imposed from outside". Inadequate information and lack of motivation for introduction of the technology accounted for a passive attitude adopted by the local population.

An entirely different situation could be observed in the Catholic and Protestant missions operating in Central Africa.

They scored greater successes in introduction of new technical-organizational solutions (e.g. solar energy in Manika near Kokrezi, mini hydro-electric power stations in Central Shaba, etc.). Unlike the cases described earlier, the missions did not restrict their attention to experiments with individual technologies but were realizing learning-by-doing programmes. They would offer entire systems of interlinked technologies to inhabitants (for instance, not only generation of electric energy but also professional training, learning how to use new technologies, application of new cultivation methods, selling of surpluses, etc.). Both the inhabitants and the missionaries were most interested in the success of appropriate technologies, since their application was visibly improving their living conditions (in several instances it had a direct impact on the further existence of the missions). Positive results scored by numerous missions and their rich experience in introduction of appropriate technologies at the micro level could (and should) be widely utilized when designing a programme of diffusion of appropriate technologies at the macro level. In the light of the above analysis, it seems that in spite of numerous difficulties and failures, common acceptance and marked acceleration of diffusion rate of appropriate technologies in Sub-Saharan Africa is already only a question of time, perhaps even not too distant.¹²

12 For the latest polemic regarding appropriate technologies see among others: R.S. Eckaus, *Appropriate Technology: The Movement Has Only a Few Clothes On*, *Issues in Science and Technology*, Winter 1987; F. Stewart, *The Case For Appropriate Technology: A Reply to R.S. Eckaus*, *Issues in Science and Technology*, vol. III, No. 4, 1987.